High Performance Computing for National Security

Advanced Simulation and Computing (ASC)

Within the Department of Energy and National Nuclear Security Administration, the ASC Program has fulfilled the responsibility for providing simulation tools to support the stockpile stewardship mission for nearly 20 years.

Computation and research to support this effort is carried out at:

- Lawrence Livermore National Laboratory (LLNL)
- Los Alamos National Laboratory (LANL)
- Sandia National Laboratory (SNL)

Lawrence Livermore National Laboratory's 20 petaflop Sequoia IBM Blue Gene/Q system was #1 on the June 2012 Top500 list.

Roadrunner supercomputer made history as the world's most powerful in June 2008 when it exceeded a sustained speed of 1 petaflop/s.

Sandia National Laboratories' ASCI Red supercomputer was the first teraflop/s computer, taking the No.1 spot on the 9th TOP 500 list in June 1997 with a performance of 1.068 teraflop/s.

Since its inception, the ASC program has funded numerous high performance computing systems at LANL, LLNL and SNL, including several systems that ranked #1 on the Top 500 list:

- ASCI Red (SNL): Jun 1997 - Nov 2000, 1.1 - 2.4 Teraflops
- ASCI White (LLNL): Nov 2000 - Jun 2002, 7.3 Teraflops
- BG/L (LLNL): Nov 2004 - Jun 2008, 71 - 478 Teraflops
- Roadrunner (LANL): Jun 2008 - Nov 2009, 1.04 Petaflops
- Sequoia (LLNL): Jun 2012 - Nov 2012, 16.3 Petaflops

ASC simulations are central to stewardship of the U. S. nuclear stockpile in the absence of nuclear testing.

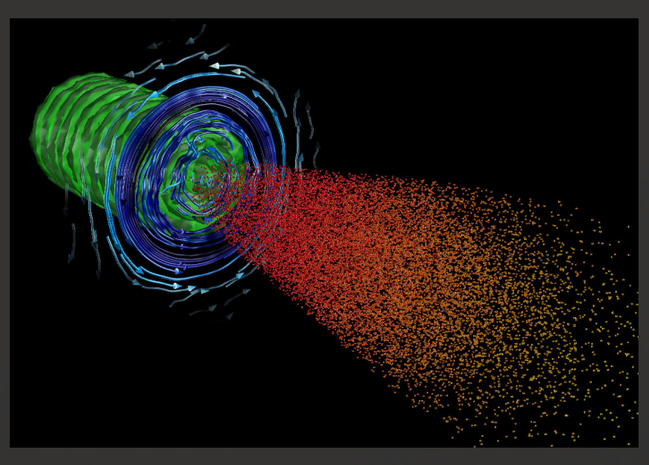
NNSA's ability to model the extraordinary complexity of nuclear weapons systems is essential to establish confidence in the performance of our aging stockpile.

ASC tools enable nuclear weapons scientists and engineers to gain a comprehensive understanding of the entire weapons lifecycle from design to safe processes for dismantlement.

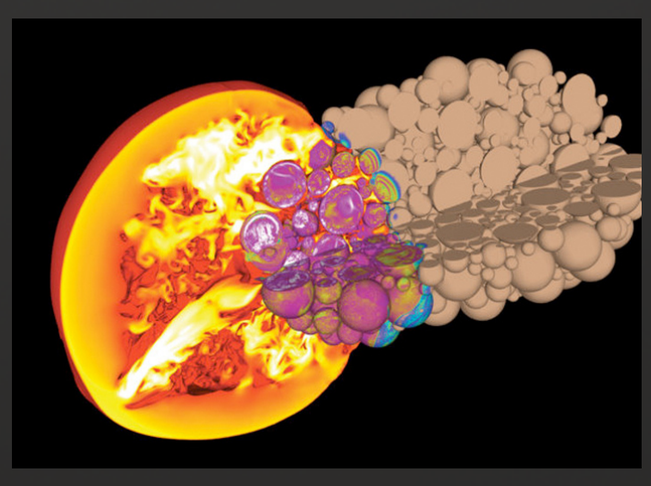
Also, through close coordination with other government agencies, ASC tools play an important role in supporting global nuclear security, emergency response, and nuclear forensics.

Program elements

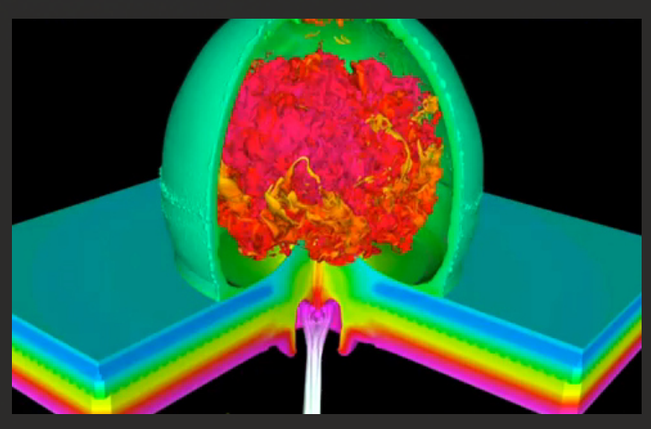
- Integrated Codes
- Physics and Engineering Models
- Verification and Validation
- Computational Systems and Software Environment
- Facility Operations and User Support



OSIRIS simulation on Sequoia of the interaction of a fast-ignition-scale laser with a dense DT plasma. The laser field is shown in green, the blue arrows illustrate the magnetic field lines at the plasma interface and the red/yellow spheres are the laser-accelerated electrons that will heat and ignite the fuel.



Scientists are using this 3D Cielo supercomputer simulation to address ways to prevent objects in space from colliding with Earth.



A computer model helps scientists understand the hydrodynamics of how solids mix and flow as a result of a high-velocity projectile striking a metal surface.

FUNDING AGENCY: NNSA Advanced Simulation & Computing Program

FUNDING ACKNOWLEDGEMENT: National Nuclear Security Agency of the U.S. DOE under contract DE-AC5206NA25396.

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LA-UR-13-28016

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